Manual for DC system type PC10

SAFETY INSTRUCTIONS

This manual must be read **before** installation, use or work on the product.

This product contains dangerous voltages that when touched can cause electric shock, burns or death.

The product must be installed by qualified personnel and according to the installation instructions. Service may only be performed by authorized service personnel. The cubicle may only be opened by authorized personnel. The protective covers and contact safety devices inside the equipment may only be removed by authorized service personnel.
The power must always be disconnected in a safe way before starting any service/maintenance.

Warning for reverse voltage. Power is supplied from several sources. The mains breaker itself will not give a completely dead condition.

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We reserve the right to make changes to the content of this manual without prior notification.

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A CIRCUIT DIAGRAM DM199

1 PRESENTATION

PC10 is a complete DC system providing uninterruptible power for e.g. switch gears, control equipment, process control, etc.

The system is built on a modular basis for easy maintenance and high flexibility. It is in its basic form a complete set of rectifier, battery, battery fuse board, distribution board and monitoring unit. The compact design makes it possible to fit even in limited spaces. The clear display and well-arranged system of menus of the monitoring unit make it easy and pleasant to work with. The rectifiers are of “plug-in” type and can be connected in parallel to increase capacity and availability.

PC10 is a basic concept aimed for adaption according to specific requirements from each customer. This means that the system may be equipped with a wide range of additional functional units whereof some of the most common are described in this manual. For other units, please se possible separate descriptions for each unit.

This description primarily deals with installation, commissioning, service, maintenance and technical data and is principally aimed for the personnel who are responsible for these areas. Equivalent descriptions of the parts of the equipment that relate to the monitoring unit are detailed in the *Manual for Monitoring unit type PCM2*. For other units, please se possible separate descriptions.

Operation is handled primarily via the monitoring unit described in the *Manual for Monitoring unit type PCM2*. This is therefore chiefly aimed at the personnel that have the day to day responsibility for the plant, but also to other personnel who have cause to work with the DC system.

For a complete description, this manual is to be used together with the description for the monitoring unit, *Manual for Monitoring unit type PCM2* and possible separate descriptions for other units.

2 SAFETY INSTRUCTIONS

This product contains dangerous voltages that when touched can cause electric shock, burns or death.

For safety reasons the concerned personnel are classified according to the following requirements for specific skills.

Authorised service personnel:

- Have electrical training and adequate experience to avoid the dangers that electricity can cause.
- Are certified to meet authority requirements for the work in question.
- Have linguistic skills that ensure that the content of this description cannot be misunderstood.
- Have undergone a product-specific training programme for authorised service personnel that are approved by KraftPowercon Sweden AB.

Qualified personnel:

- Have electrical training and adequate experience to avoid the dangers that electricity can cause.
- Are certified to meet authority requirements for the work in question.
- Have linguistic skills that ensure that the content of this description cannot be misunderstood.

Installation, service, maintenance and fault tracing may only be carried out by authorised personnel and in accordance with the installation instructions.

The protective covers and contact safety devices inside the equipment may only be removed by authorised service personnel.

3 TECHNICAL DATA

3.1 GENERAL

The specifications given here are based on the basic concept. Since PC10 is always adopted according to specific requirements from each customer, other data may apply.

3.2 ELECTRICAL DATA

3.2.1 Assortment

PRM1

PRM3

PC10 may be based on rectifiers of either type PRM1 or type PRM3. This manual is based on the most common choice which is rectifier of type PRM1. In case of PRM3, please use the *Manual for Charging Rectifier type PRM3* as a complementary description.

The rectifier of type PRM1 equipped with up to four rectifier modules. The table below is based on fully equipped rectifier, i.e. four modules.

PC10			Rectifier module	
Model designation	U_{NOM} (V_{DC})	I_{RATED} (A)	I_{RATED} (A)	Model designation
PC10 24/240	24	240	60	V1500B
PC10 48/48	48	48	12	L0600A-IW
PC10 48/100		100	25	L1250A-IW
PC10 48/200		200	50	L2500A-IW
PC10 110/40	110	40	10	L1250K
PC10 125/40	125	40	10	L1250K

3.2.2 Common electrical input data

The given data are valid for rectifier of type PRM1.

Rated voltage .....110[*1]/115[*1]/120[*1]/220/230/240 V AC 1- phase[*2]
Frequency .....47 – 63 Hz
Power factor.....> 0.95 at 230 V_{AC}, full load
Connection .....Screw terminal block, 0.2 – 6 mm^2

[*1]: Only applies to certain models, see Electrical data for rectifier module.
[*2]: Each individual rectifier module is supplied from one phase, but several modules may be divided into separate phases.

3.2.3 Common electrical output data

The given data are valid for rectifier of type PRM1.

Voltage regulation (static).....<±0.5% of nominal output voltage
Voltage regulation (dynamic) .....<±1% within 3 seconds, 0-100 / 100-10 % load change
Current regulation .....<±1% of rated current
Setting range, current limit .....0 - 100% of rated current
Ripple voltage .....<0.1 $\%_{RMS}$

Ripple current .....<1% of rated current
Efficiency, typical.....>90% at 230 V_{AC}

3.2.4 Electrical data for rectifier module

The given data are valid for rectifier of type PRM1.

Model designation, rectifier module	Output data			Input data			Power loss[*2]
	U_{NOM} (V_{DC})	Setting range (V_{DC})	I_{RATED} (A)	Voltage range (V_{AC})	Mains power[*1] (VA)	Mains current[*1] (A_{rms})	
V1500B	24	21 – 28	60	180 - 264	1960	10.0	187
L0600A-IW	48	42 - 56	12	85 - 295	800	4.1	92
L1250A-IW			25	85 - 295	1600	8.2	156
L2500A-IW			50	150 - 295	3150	16.1	312
L1250K	110/125	97.5 - 145	10	90 - 300	1410	7.2	139

[*1]: max at 195 V_{AC}
[*2]: typical at 230 V_{AC} and full load

3.2.5 Electrical data for distribution fuse board DM199

Type DM199	Fuse ways	Max fuse rating (A)	Fuse type
DM199 9xDII	9	25	Diazed type DII
DM199 6xDIII	6	63	Diazed type DIII
DM199 9xMCB	9	Acc. to spec.	Miniature circuit breaker (MCB)

Power consumption ..... 1 W (24 V), 2 W (48 V), 2 W (110 V), 2.5 W (125 V)
Insulation between fuse ways... >1 Mohm
Alarm outputs ..... Relay, closed circuit working
250 VAC, 5 A, AC1
24/48 VDC, 0.3 A at L/R=40 ms
125 VDC, 0.15 A at L/R=40 ms
250 VDC, 0.12 A at L/R=40 ms
Indications ..... Red/Green LED per fuse way
Settings..... Switch per fuse way for monitoring activation/de-activation
Connection, fuse way output ... 0.5 - 10 mm^2, slide disconnect screw terminal block
Connection, alarm output ..... 0.2 – 2.5 mm^2, knife disconnect screw terminal block

3.2.6 Electrical data for battery fuse board

Design..... Pole separated in plastic housing
Fuse type..... NH00, knife blade fuse
Number of fuse ways ..... 4-8 depending on design
Battery cable, internal battery .. 35 mm^2, double insulation

3.2.7 Electrical data for capacity test connector

3.2.7.1 General

Connection for capacity test load is generally implemented as a screw terminal block placed on the rear plate inside the cubicle or as a CEE connector placed on the cubicle door, but other alternatives may also occur. The given data are valid only for basic design.

3.2.7.2 Screw terminal block

Connection ..... 4 - 35 mm^2, screw terminal block
Maximum load..... 35 A

3.2.7.3 Connector

Connection ..... CEE connector type UIS 232-6
Maximum load..... 32 A

3.2.8 Electrical data for battery

3.2.8.1 Internal battery

Battery type..... Vent regulated
Maximum battery blocks..... Limited by physical size, typical 9 blocks at 110V
Maximum capacity ..... Limited by physical size, typical 100Ah at 9 blocks and 110V

3.2.8.2 External battery

Battery type..... Optional
Maximum battery blocks..... No limit
Maximum capacity ..... No limit

3.2.9 Electrical data for inverter

The given data are valid for inverters of type INVB with 230 VAC output.

Maximum external fuse for bypass mains input is based on internal cable dimensions. Minimum recommended fuse is based on the rated power of the inverter.

Maximum distribution fuse (output fuse) is based on a trip time of maximum 50 mS. This is normally short enough for objects on the other fuse ways to be considered as no interruption.

Model INVB	Bypass mains fuse (A)		Distribution fuse, maximum (A)		
	Minimum	Maximum	Fuse link, gG	MCB, curve B	MCB, curve C
INVB500	6	10	-	-	0.25
INVB1000	6	10	-	1.6	0.75
INVB2000	10	10	-	3	1.6
INVB4000	20	20	2	6	3

3.2.10 Electrical data for other units

See separate description/datasheet for each unit.

3.3 ENVIRONMENTAL DATA

Class of enclosure .....IP21 as per EN 60529, IP42 as option
Cooling .....Temperature controlled fans in rectifier modules, otherwise natural convection
Ambient temperature (specified data applies).....0 to +40 °C
Storage temperature .....-40 to +70 °C
Humidity.....<90 % RH, non-condensed
Altitude a.s.l.....<2000 m
Noise level, at 25 % load.....<50 dBA, 1 rectifier module
<54 dBA, 2 rectifier modules
<56 dBA, 3 rectifier modules
<57 dBA, 4 rectifier modules

3.4 MECHANICAL DATA

Design..... Floor cabinet with 19" rack frame
Placement..... Standing on floor indoors in dry and clean area

Weight ..... Typical 100-150 kg, without batteries
Dimensions ..... Typical 2051/740/654 mm (h/w/d)
Colour ..... RAL 7035 light grey
Cable inlet ..... From beneath, from above as option

3.5 CONFORMITY WITH STANDARDS

EN 60529 ..... Protection degree
EN 50178 ..... LVD. Electronic equipment, including power electronics in electrical power installations.
EN 50272-2 ..... Safety requirements for secondary batteries and battery installations
EN 61000-6-2 ..... EMC. Immunity of equipment in an industrial environment
EN 61000-6-4 ..... EMC. Emission from equipment in an industrial environment

4 FUNCTIONAL DESCRIPTION

4.1 GENERAL

PC10 is a complete DC system that in its most basic design includes rectifier, battery, battery fuse board, distribution board and monitoring unit. Since PC10 is always adopted according to specific requirements from each customer, a range of additional functional units may be included. In addition to the basic design, some of them are described here.

PC10 may be based on either rectifier of type PRM1 or PRM3. This manual is based on PRM1 since it is the most common choice. For the PRM3 alternative, see *Manual for Charging Rectifier type PRM3* as complementary description.

Most of the function is associated with the monitoring unit. This is described in the *Manual for Monitoring unit type PCM2*. Only functions added on system level are discussed in this section.

4.2 SINGLE LINE DIAGRAM

In *Figure 4-1* a single line diagram for PC10 in 110 V design is shown with 24 V DC/DC converter and 230 V inverter added. In addition to this a number of other options may occur, as e.g. double systems, alarm panels, etc. For these possible options, please see customer specific documentation.

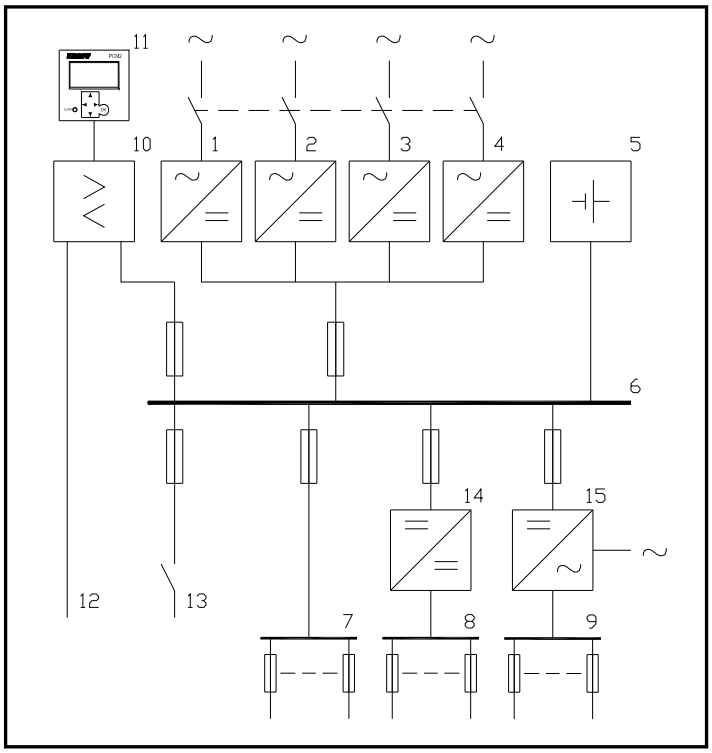


Figure 4-1 Single line diagram PC10, example

1-4: Rectifier modules
5: Battery
6: Battery fuse board
7: Distribution fuse board 110VDC
8: Distribution fuse board 24VDC
9: Distribution fuse board 230VAC
10: PCM2 I/O unit
11: PCM2 Operator's terminal
12: Alarm outputs
13: Capacity test terminals
14: DC/DC converter 110VDC/24VDC
15: Inverter 110VDC/230VAC

4.3 RACK FOR RECTIFIER MODULES AND OPERATORS PANEL

Rectifier units together with the operator's panel are mounted in a separate rack unit.

The operator's panel, also called the Display Module, is the unit that is used as interface to the user. It is mounted as a module to the left of the rectifier modules.

The rectifier modules are of plug-in type. For adaptation of desired capacity, the rack unit may be equipped with up to four modules.

4.4 RECTIFIER MODULES

The rectifier modules are of plug-in type and can be replaced during operation. There is room for up to four modules in parallel.

There are three indicator lamps on the front of the module:

- AC OK - Green -> Mains OK
  Off -> Mains power failure
- DC OK - Green -> DC OK
  Off -> Low DC voltage
- ALM - Red -> Alarm
  Off -> OK

4.5 MONITORING UNIT PCM2

4.5.1 General

PCM2 is designed to monitor and to a certain extent control a DC system based on batteries, rectifiers and distribution.

The main functions are:

- Monitoring of system parameters such as voltage, current, earth fault resistance, temperature, and others.
- Alarm management through analysis of own measurement data, automatic tests and collection of data from external units.
- Alarm indication in clear text on display, LED for general alarm and relay outputs for external alarm handling.
- Control of the charging process such as equalizing charging, temperature controlled float charging voltage and tests with lowered voltage (battery circuit test).
- Operator communications via display, push buttons and LEDs for alarm indication.

For more information, see *Manual for Monitoring unit type PCM2*.

4.5.2 Operator's panel

The operator's panel is the unit used as the user interface. It contains a graphic display, push buttons, LEDs for alarm indication and an internal microprocessor.

As an option it is possible to connect another operator's panel for use for example in a control room.

4.5.3 I/O unit

The I/O unit contains an adapter for the external connections required for the monitoring unit. It is an interface to the surrounding system by using circuits for digital inputs/outputs, measurement circuits, power supply and microprocessor. Its normal physical position is on a DIN rail inside the cabinet.

4.5.4 Test contacts

There are short-circuit proof test contacts alongside the operator panel, for checking of the battery voltage. The test contacts are aimed for 4 mm isolated plugs of safety type but also accept 4 mm banana plugs.

4.6 BATTERY

The battery is built up of a number of battery blocks connected in series. They can be placed either internal, i.e. inside the PC10 enclosure, or external on a separate stand. In case of internal placement, the battery is always of VR-type, i.e. vent regulated blocks. External batteries can be of any type.

The mid voltage is measured in order to monitor the symmetry of the battery.

4.7 BATTERY FUSE BOARD

The battery fuse board is the most upstream level for distribution of the DC power. Since fuses are normally not permitted between the battery and the battery fuse board, the battery fuse board is of pole separated and short-circuit proof design. The fuses are of the NH00 knife blade type.

4.8 DISTRIBUTION FUSE BOARD

4.8.1 DC

The distribution fuse board is generally the next level below the battery fuse board for distribution of the DC power. In some cases however, there is an additional level between the battery fuse board and the distribution fuse board which usually is named the Main Fuse Board which has Diazed fuse links of type DIII. PC10 may be equipped with a number of distribution fuse boards of type DM199 with nine fuse ways each. The boards may be equipped with either Diazed fuse links of type DII or DIII, or Miniature Circuits Breakers (MCB).

The distribution board has two-pole zero voltage monitoring with indicator lamp for each fuse way and a common alarm output for the complete board. A fuse fault generates a color shift of the indicator lamp from green to red and the common alarm relay will be de-energized thus causing an alarm. Non-used fuse ways can be de-activated so they will not have any effect on the alarm output. The corresponding indicator lamp is turned off to indicate this condition.

The left short side of the board has a folding plastic case that holds a fuse list.

4.8.2 AC

When the PC10 is equipped with an inverter it is generally followed by an AC distribution fuse board. Beside single-pole fuse ways, it is normally identical to the DC distribution fuse board discussed above in design and function. However, sometimes alternatives equipped with MCB + auxiliary contacts occur.

4.9 DC/DC CONVERTER

As an alternative to a separate complete battery system for lower voltages, the ordinary battery together with DC/DC converters may well be used to create the desired DC power, normally 24 or 48 V. The DC/DC converter has an internal isolation barrier which gives total galvanic isolation between the two systems.

By connecting DC/DC converters in parallel the output power may be increased. Adding output diodes will create redundancy as well.

4.10 INVERTER

For uninterruptible AC power, the system may be equipped with an inverter. It creates AC power using battery voltage.

The inverter is generally equipped with a manual bypass switch that switches the feeding of the load from the inverter to a bypass mains power. This is useful during service on the inverter which then can be done while still maintaining power to the load.

For more information, see *Manual for Inverter type INVB*.

4.11 DOUBLE SYSTEMS

4.11.1 General

Double systems means that there are two separate system parts, system A and B, each equipped with rectifier and battery. By means of cross-link breakers the load can manually be transferred between the two system parts. During this operation the system parts needs to cooperate, mainly concerning earth resistance measuring, equalizing charging and battery circuit test. This is described in this section.

4.11.1.1 Cross-link breakers

By means of cross-link breakers you can control which battery that should to feed the load. There are four positions:

1. Feeding from battery A.
2. Feeding from battery B.
3. Feeding from battery A+B simultaneously.
4. The load has no power, i.e. it is isolated from the battery system.

Position 3 is used as an intermediate position during switching between position 1 and 2 in order to get an uninterrupted changeover. Unlike the other positions where the systems are working as two completely independent systems, they are in position 3 connected. It is of course possible to use this position permanently, even if the recommendation is to use it only temporarily e.g. during service and maintenance.

The load is normally divided into at least two groups with each group working as above by means of two cross-link breakers.

By adding auxiliary switches to the cross-link breakers and connect them to the monitoring unit, a number of problems are taken care of that otherwise would arise in a double system.

4.11.1.2 Earth resistance measuring

There should never be more than one earth resistance measuring equipment at a time connected in a system. Otherwise there will be a measuring error due to measuring of each others input impedance. By adding auxiliary switches to the cross-link breakers and connect them to specific inputs on the monitoring unit, this will be dealt with automatically.

For detailed information, see *Manual for Monitoring Unit type PCM2*.

4.11.1.3 Battery circuit test

As long as the both system parts are separated, the system parts will perform battery circuit tests independent of each other. When they are connected, both systems have to do a synchronized voltage drop for a meaningful test result. By connecting certain input and output ports between the monitoring units of the both systems, this will be dealt with automatically.

For detailed information, see *Manual for Monitoring Unit type PCM2*.

4.11.1.4 Equalizing charging

Equalizing charging means charging with increased voltage level. By temporarily moving the load to the other battery during the equalizing charging using the cross-link breakers, you avoid exposing the load for the increased voltage level.

If you need to completely eliminate the risk of increased voltage level to the load, it is possible to block any equalizing charging attempts while the battery in question is connected to the load. This is done using auxiliary switches on the cross-link breakers connected to specific inputs on the monitoring unit. In series with the auxiliary switches you can also connect a flow sensor. By letting the flow sensor measure the air flow in the battery room vent fan you can prevent equalizing charging during ventilation loss and thereby eliminate hydrogen explosion hazard.

For detailed information, see *Manual for Monitoring Unit type PCM2*.

4.11.1.5 Loadsharing

Rectifier modules within a single system operate using active loadsharing. Loadsharing between two connected systems however, will only be done passive utilizing the RI-compensation that comes naturally in the cables between the system parts.

4.12 OTHER FUNCTIONAL UNITS

All PC10 systems are unique in the way that they, unlike a standard product, are manufactured according to a customer specification. This means that different kinds of functional units beside the already mentioned may exist. Due to the range of variation it would be impossible to describe them all here why we in these cases refer to separate descriptions for each unit.

4.13 FUNCTIONS

4.13.1 General

Only the most important functions are specified here. For more information, see the *Manual for Monitoring unit type PCM2* and separate descriptions for possible other functional units.

4.13.2 Float charging

Float charging is the normal operating mode determined by the battery. The voltage level is to be set according to the battery manufacturer's instructions.

For more information, see the *Manual for Monitoring unit type PCM2*.

4.13.3 Equalization charging

Equalization charging means charging at an increased voltage level over a limited period. It is used partly for the initial charge, and partly for equalizing cell voltages if spreading has occurred.

A digital input on the monitoring unit can be used for blocking of the equalizing charging during connected load and/or lack of battery room vent flow.

For more information, see the *Manual for Monitoring unit type PCM2*.

WARNING! *Generally, batteries of VR-type (vent regulated) should not be subject to equalization charging. For some battery types equalization charging could even be harmful to the batteries. Always follow the battery manufacturer's instructions.*

4.13.4 Battery circuit test

A battery circuit test is automatically carried out at optional intervals (normally once a day). The test involves checking that the entire battery circuit, i.e. not only the battery block, is in working order.

For more information, see the *Manual for Monitoring unit type PCM2*.

5 OPERATION

5.1 GENERAL

Most of the operation is associated with the monitoring unit. This is described in the *Manual for Monitoring unit type PCM2*. Operations for some other basic functional units are detailed in this section. For functional units beyond this, see possible separate descriptions for each unit.

PC10 may be based on rectifiers of either type PRM1 or PRM3. This manual is based on PRM1 since it is the most common alternative. For the PRM3 alternative, see *Manual for Charging Rectifier type PRM3* as a complementary description.

5.2 MAINS POWER

For mains power feeding of the rectifier modules there is a breaker which is normally located on the rear plate of the cubicle.

Note that the breaker is only breaking the mains power to the rectifier modules. The monitoring unit will still be working due to power from the battery.

WARNING: *Note that the mains breaker does not make the equipment completely dead. For total dead state, the battery and other possible power sources must also be disconnected.*

5.3 RECTIFIER MODULES

There are three indicator LEDs on the front of the rectifier module with the following functions:

- AC OK - Green -> Mains OK
  Off -> Mains power failure
- DC OK - Green -> DC OK
  Off -> Low DC voltage
- ALM - Red -> Alarm
  Off -> OK

When the module gives an alarm you have the option of finding out the cause of the alarm in detail via the operator panel menus, see the *Manual for Monitoring unit type PCM2*.

The modules are of the "plug-in" type and can in principle be replaced during operation. For more information, see the section INSTALLATION INSTRUCTIONS.

5.4 BATTERY FUSE BOARD

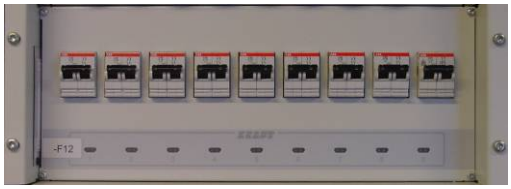
The battery fuse board normally holds six or seven fuses of knife blade type (NH00), but other numbers do occur. Fuses for plus and minus are located in separate plastic boxes for short-circuit proof design. For a fuse way description, see site specific circuit diagram.

By removal of all fuses in the battery fuse board and switching off the mains breaker the cubicle can be put into a neutral condition, apart form the batteries themselves, the battery fuse box copper bar and a possible bypass mains for inverter.

DANGER: *When working with knife blade type fuses, uses safety approved tools only. Remove all loads before working with knife blade type fuses due to arcing hazard!*

Do not use fuses with higher ratings than permitted, see marking signs in the fuse board. Use insulated tools only and follow the regulations stated for working with live parts.

5.5 DISTRIBUTION FUSE BOARD



PC10 is usually fitted with distribution fuse boards of type DM199 equipped with nine fuse ways each. The fuses can be either Diazed type DII/DIII or Miniature Circuit Breakers (MCB).

Each fuse way in the DC fuse boards is equipped with two-pole zero voltage monitoring with LED indication. A common sum alarm is forwarded to the monitoring unit. Unused fuse ways can be de-activated, see section INSTALLATION INSTRUCTIONS.

The LED indications have the following function:

Green	-	Fuse way OK
Red	-	Fuse fault
Off	-	Fuse way monitoring de-activated

The left short side of the board has a folding plastic case that holds a fuse list. The list is normally left empty by delivery. For a template file in Excel-format, please contact KraftPowercon Sweden AB.

5.6 MAIN FUSE BOARD

Sometimes there is an intermediate fuse level between the battery fuse board and the distribution fuse board. It is usually called the Main Fuse Board and normally holds fuse links of Diazed type DIII. A common combination of fuse ratings to ensure selectivity is 63 A in the battery fuse board, 35 A in the main fuse board and up to 20 A in the distribution fuse board.

5.7 CAPACITY TEST

Since the capacity of the battery is decreasing by age, a capacity test should be done regularly to verify the actual capacity of the battery.

The capacity test breaker is normally located on the rear plate inside the cubicle. Connection of the external test load is usually done via a screw terminal, also placed on the rear plate inside the cubicle. Alternatively, the load is connected via a CEE connector on the door (see the right picture). In that case also the breaker may be located on the door, close to the CEE connector.

A manual capacity test is done like this:

1. Connect an external test load to terminal or CEE connector.
2. If it is a double system the load should be transferred to the other battery during the test.
3. Turn off the charging by switching off the mains breaker.
4. Initiate the discharging by switching on the capacity test breaker. Use an external instrument to measure the discharged capacity (Ah).
5. When the desired final voltage is reached the test is cancelled by first turning off the capacity test breaker and then start the charging process by turning on the mains breaker. During the time the battery voltage is below the setting of the float charging level the rectifier will operate at its maximum current limit.

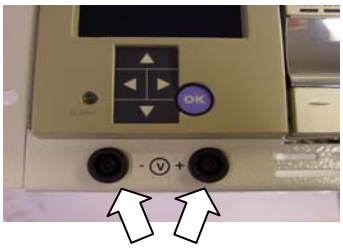
5.8 BATTERIES

Depending of the actual PC10 design, the batteries are placed either internally or externally.

For maintenance and other handling of the batteries, follow the battery manufacturer's instructions.

5.9 TEST CONTACTS

When measuring the battery voltage you should avoid measuring directly on the battery poles due to the risk of arcing in the event of a possible short circuit. Instead, use the short-circuit protected test contacts located just below the operator panel.



The test contacts accept 4 mm insulated safety plugs, and also 4 mm banana plugs. To avoid measurement errors, the voltmeter used should have high internal resistance, 10 Mohm or better.

5.10 DC/DC CONVERTER

DC/DC converters are normally equipped with an indication showing OK/Alarm but do not have any manual operation functions. Therefore there are no real operations to describe in connection with DC/DC converters.

5.11 INVERTER

The inverter is equipped with a manual bypass unit. Its purpose is to make it possible to switch in bypass mains instead of the inverter thus allowing service and replacement of the inverter without interrupting the power to the load.

Instruction for uninterruptible switching to bypass mains mode:

1. Initial position: The bypass switch (pointed out by the arrow) is in position 1 (Normal), lamps indicating "Inverter in Inverter mode".
   In case of an inverter fault the lamps would instead indicate "Inverter in Mains mode". In that case, continue from paragraph 4.
2. Turn the inverter into mains mode. The approach is slightly different depending on the inverter model, therefore see the *Manual for Inverter type INVB* when needed.
3. Check that the lamps now indicate "Inverter in Mains mode".

4. Turn the bypass switch into position 2 (Bypassed).
5. It is now safe to turn off the inverter without consequences for the load. NOTE: For service or replacement, also switch off the breaker for incoming DC to the inverter before the connections on the front are removed.

Instruction for uninterruptible switching back to inverter mode:
1. Initial position: The bypass switch is in position 2 (Bypassed), the inverter is turned off.
2. Turn on the breaker for incoming DC to the inverter.
3. Turn on the inverter. After a short while the inverter should have synchronized to the bypass mains and will then automatically switch over to inverter mode.
4. Check that the lamps now indicate "Inverter in Inverter mode".
5. Turn the bypass switch into position 1 (Normal).

For operation of the inverter itself, see the *Manual for Inverter type INVB*.

5.12 CROSS-LINK BREAKERS

By means of cross-link breakers you can control from which battery the load should be supplied. The cross-link breakers are placed either inside the cubicle on the rear plate according to the example in the upper picture (by the arrows) or on the door front according to the example in the lower picture.

Normally, infeed from battery A is controlled by the left breaker and infeed from battery B by the right breaker.

Instruction for uninterruptible infeed changeover from battery A to battery B:
1. Initial position: Left breaker A on, right breaker B off.
2. Turn on breaker B. The load is now temporarily supplied from both of the batteries.
3. Turn off breaker A.

Instruction for uninterruptible infeed changeover from battery B to battery A:
1. Initial position: Left breaker A off, right breaker B on.
2. Turn on breaker A. The load is now temporarily supplied from both of the batteries.
3. Turn off breaker B.

Paragraph 2 is always used as an intermediate position to achieve an uninterruptible changeover. Of course it is also possible to use this position permanently, even if the recommendation is to use it only temporarily during e.g. service and maintenance.

5.13 OTHER FUNCTIONAL UNITS

For possible other functional units, please see separate descriptions for each unit.

6 INSTALLATION INSTRUCTIONS

6.1 SAFETY INSTRUCTIONS

DANGER! *This product contains dangerous voltages that when touched can cause electric shock, burns or death. Protective earth must always be connected in a reliable way to avoid the risk of live parts in the equipment in the event of faults. No live parts are permitted during installation. During all handling of batteries, the instructions stated by the battery manufacturer must be followed. The product must be installed by qualified personnel (see section 2, SAFETY INSTRUCTIONS).*

NOTE! *Check both before and after setting-up that the equipment does not have any mechanical damage. Check that the equipment is designed for the existing rated voltage. Cables for input and output power must be correctly dimensioned to avoid fire hazard.*

CAUTION! *For all handling of the batteries, follow the battery manufacturer's safety instructions.*

6.2 GENERAL

Installation of parts belonging to the monitoring unit is not dealt with in this manual. For complete installation instructions these instructions should therefore be used in combination with the installation instructions included in the *Manual for Monitoring unit PCM2.*

The cubicles are normally shipped without installed rectifier modules. Instead, they are packed separately to be mounted into the cubicle during installation.

6.3 STORAGE AND PROTECTION

6.3.1 Enclosure

Storage is to be in a dry area and at a temperature within the -40 to +70 °C range.

6.3.2 Battery

If the batteries are not installed immediately, they should be stored in a clean, cool and dry environment. Generally, a maintenance charging should be done at least every six month. If possible, the storage temperature should not exceed +20 °C. Otherwise the maintenance charging should be done more often. For additional information, see the battery manufacturer's recommendations.

6.4 ERECTION

6.4.1 Enclosure

The equipment is intended for placement on floor in a dry, clean environment that is free from conductive dust. At least 40 mm free space to the wall should be left on the rear for ventilation reasons. In the bottom of the enclosure, there are holes prepared for bolting to the floor.

Cable inlet is from below as standard. For IP21 version the floor is open while higher IP classes has a detachable cover plate that retrospectively can be fitted with cable inlets as e.g. cable glands.

Cable inlet from above also occurs. In that case the roof plate is equipped with a number of FL21 openings. By delivery they are normally equipped with a FL21 cover plate.

6.4.2 Batteries

6.4.2.1 Internal batteries

Place the batteries as far to the bottom of the enclosure as possible. Normally, the recommended placement is shown in the layout drawing.

NOTE: Only vent regulated batteries, also called sealed or VR-batteries, is permitted for installation inside the PC10 enclosure.

6.4.2.2 External batteries

Mount the batteries according to the instruction that is enclosed with the battery stand.

6.4.3 Rectifier modules

The rectifier modules are normally packed separately and are to be put in place during the installation. The rack module slots should be equipped with modules starting from the leftmost position and with possible spare slots to the right.

Carefully slide the module into its place and push it all the way to the bottom. Finally, press in the handle until it snaps in place.

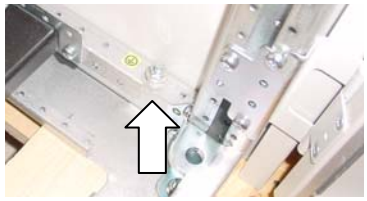
6.5 ELECTRICAL INSTALLATION

6.5.1 General

The equipment is designed for permanent installation. Protective earth must be connected before any other installation.

6.5.2 Earthing

For earthing and shielding the earth-bars in close vicinity to the terminal blocks are used.



For equipotential bonding, there is a M8 bolt located on one of the gable profiles near the floor. In case of cable inlet from above there is another one located on the corresponding place near the roof.

6.5.3 Mains voltage

6.5.3.1 External fuse rating

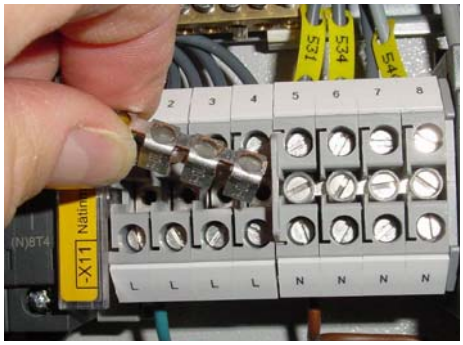
The size of the external primary fuse is selected as follows:

1. Find the maximum mains current for the type of rectifier module in question from the table in section Electrical data for rectifier module.
2. Multiply it by the number of installed rectifier modules.
3. Choose the next highest fuse rating.

NOTE: If you choose to feed the rectifier modules from different phases (see below), point 2 above must of course be suitably modified.

6.5.3.2 Connection of rectifier

Each rectifier module has its own terminal blocks for phase and neutral. It is therefore possible to select between feeding the modules from individual phases or to link two or more to the same phase. To simplify this, the terminal blocks are fitted with connection links. The links can be cut to suit the required number of poles. At delivery, all mains inputs are connected in parallel.



NOTE: When cutting the connection links, ensure the "tag" is removed completely, so that the insulation distance is not reduced.

The feeding network should be of TN-S type in order to avoid the risk of stray current.

6.5.3.3 Connection of inverter

For connection of bypass mains and suitable external fuse, see section 3.2.9 Electrical data for inverter, site specific circuit diagram and *Manual for Inverter type INVB*.

6.5.3.4 Connection of other units

For possible mains connection of other units, see specific description for each unit.

6.5.4 Batteries

6.5.4.1 General

In addition to the instructions given here, the battery manufacturer's instructions must be followed.

The battery fuse board is of short-circuit proof design which makes it possible to exclude fuses in the link between battery and the battery fuse board. This is strongly recommended since the short-circuit current from the battery is limited, which in turn would make it difficult to ensure selectivity to downstream fuses.

Remove all fuse links in the battery fuse board before the installation of the battery.

Avoid generating higher and higher battery voltage by serial connection. Instead you should start with minor parts of serial connected groups of battery blocks. For each individual group, the polarity and voltage is checked. Then connect group after group while checking polarity and voltage as every new group is added. In this way the risk of faulty connection is minimized.

Restore all the protective covers on the batteries.

DANGER! *Always follow the battery manufacturer's safety instructions!*

WARNING! *The un-fused cabling between the battery and the battery distribution board must be short-circuit proof along the whole distance. This means separate double insulated cables for each pole placed separated from cable of opposite pole and other cables and combustible substances. Double insulation means two independent insulation layers and can be achieved in a few ways, like the following examples:*

- *Use underground cable, like FKKJ. Isolate (i.e. do not use) the sheath and use all conductors in parallel.*
- *Use insulated single cable, like RK, and place it into a plastic pipe.*
- *Use readymade double insulated cable, like RKK or certain types of welding cable.*

6.5.4.2 Internal battery

Place the battery blocks on the corrosion protected beams (see picture) as normally shown in the enclosed layout drawing. Connect the battery using the double insulated cables that are already connected to the battery fuse board (left arrow). Please notice the cable placement instructions in the general instructions above. Measure the voltage in the battery fuse board and check that the voltage and polarity is correct.

Connect the enclosed short-circuit protected cable set for mid voltage measurement according to the *Manual for Monitoring unit type PCM2.* A spade terminal for mounting on battery bolt M6 and M8 is enclosed. The point of connection should be as close to the electrical midpoint of the battery as possible. In case of an uneven number of cells, the exact midpoint is physical unreachable. Preferably, the battery pole on the minus side of the midpoint is chosen.

The enclosed temperature sensor (option, see right arrow) is normally already connected. Place the sensor on a spot of the battery that best represents the mean temperature of the battery, normally the most central point of the battery. Should it not already be done, connect the sensor according to the *Manual for Monitoring unit type PCM2*.

6.5.4.3 External battery

Make a short-circuit proof installation according to the above general instruction. Make a connection from the battery to the battery connection terminals located in plastic boxes on the rear mounting plane of the PC10 enclosure. See to that the double insulation is intact all the way into the plastic boxes. Depending on the size of the board, the plastic box exists in a couple of different designs.

Plastic box for up to six fuse ways (see the upper picture): Pull in the battery cable through the gland of the box. Provide the cable end with a tube cable lug suitable for an M8 bolt. Fold the cable 180 degrees and screw the cable lug on to the busbar according to the upper picture.

Plastic box for up to eight fuse ways (see the lower picture): Pull in the battery cable through the gland of the box. Provide the cable end with a tube cable lug suitable for an M10 bolt. Screw the cable lug on to the connector plate of the busbar shown on the lower picture.

When calculating the battery cable area you should, beside ordinary standards and rules, also consider the voltage drop. The voltage drop should not exceed 2 % of rated voltage at maximum current. The cable dimension should however not be less than 25 mm^2.

Connect the other end of the battery cable to the battery. Measure the voltage in the battery fuse board and check that voltage and polarity is correct.

Connect the enclosed short-circuit protected cable set for mid voltage measurement according to the *Manual for Monitoring unit type PCM2.* A spade terminal for mounting on battery bolt M6 and M8 is enclosed. The point of connection should be as close to the electrical midpoint of the

battery as possible. In case of an uneven number of cells, the exact midpoint is physical unreachable. Preferably, the battery pole on the minus side of the midpoint is chosen.

The enclosed temperature sensor (option) is connected according to the *Manual for Monitoring unit type PCM2*. Place the sensor on a spot of the battery that best represents the mean temperature of the battery, normally the most central point of the battery.

If the cable for battery mid-point measuring and/or temperature sensor needs to be extended there are no extra requirements for cable or joint box beyond ordinary electrical installation standards. The class of insulation is decided based on the battery voltage.

6.5.5 Rectifier modules

The rectifier modules are normally packed separately and are to be put in place during the installation, see section 6.4.3.

The modules can in principle be replaced during operation. However, we recommend disconnection of the mains supply first.

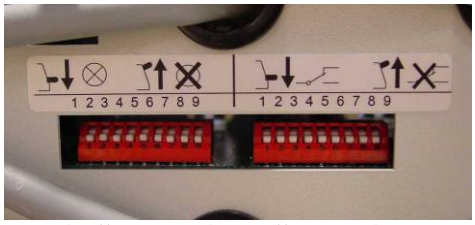
Press bottom left (see figure above) to release the module. This releases a handle that can be pulled out to enable the module to be extracted from its position.

The module is installed in reverse order by carefully pushing it into place all the way to the bottom. Finally press the handle until it snaps in place.

CAUTION! *Check carefully that the rectifier modules have the correct rated voltage.*

6.5.6 Settings of Distribution Fuse board DM199

Settings available for distribution fuse board DM199 are activation/deactivation of alarms from each separate fuse way. The meaning of deactivation is for possible unused fuse ways not to cause alarms. An alternative to deactivation is to provide even unused fuse ways with fuses.



Activation/deactivation of alarm indication and alarm relay is done via the two DIL-switches on the rear of the board. Each DIL-switch holds 9 individual switches numbered from 1 to 9 corresponding to fuse way 1 to 9. The left DIL-switch (seen from behind) controls the LED indications while the right switch controls the sum alarm relay. Switch in downward position is normal position (activated) while upward position means deactivation, i.e. turned off LED and no effect on the alarm relay.

6.5.7 External load

External DC loads distributed via distribution fuse boards of type DM199 are connected to disconnect screw terminal blocks typically named X31 for distribution fuse board F11, X32 for distribution fuse board F12, etc.

Terminals 1-18 are for loads while 19-21 are sum alarm outputs from the distribution fuse board.

Output from fuse way 1 is on terminal 1-2, fuse way 2 is on terminal 3-4, etc. Odd numbers are positive pole and even numbers negative pole.

The sum alarm output is a double-throw relay contact as follows:

- Terminal 19 - Open during alarm (NO)
- Terminal 20 - Closed during alarm (NC)
- Terminal 21 - Common (C)

If desired, the alarm output may be connected to the alarm input "Fuse fault" on the monitoring unit, see the *Manual for Monitoring unit type PCM2*.

Also a possible inverter is generally equipped with a distribution fuse board of type DM199. Type of terminal blocks, terminal numbering and type of alarm output may differ depending on customer's specification. Therefore, for connection of AC loads see site specific documentation. Also see *Manual for Inverter type INVB*.

6.5.8 I/O unit

All the connections to the monitoring units are grouped in a unit called the I/O unit. It is normally located on a vertical DIN rail together with terminal blocks on one of the gables of the cubicle. The connectors on the I/O unit are pluggable, i.e. they can be removed for better accessibility during installation. This is connection point for cables for measuring, outgoing alarms, etc. For more information about these connections, see *Manual for Monitoring unit type PCM2.*

6.5.9 Operator's panel

The operator's panel is already installed by delivery. The following description is mainly intended for future service.

To release the operator's panel, press the upper part of the panel causing a magnetic lock to disengage (see upper figure).
Pull the upper edge so that the magnet releases and then pull the lower edge free from the spring catch (lower figure). There are two wires on the rear of the panel, if these are released the panel can be removed completely.

To refit the panel, first connect the two wires. Then check that both the magnetic lock and the spring lock are extended. Press the lower edge onto the spring lock and then the upper edge onto the magnetic lock until it clicks into place.

6.5.10 Other units

For possible other units, see separate description for each unit.

7 STARTING UP

7.1 SAFETY INSTRUCTIONS

DANGER! *This product contains dangerous voltages that when touched can cause electric shock, burns or death. All contact safety devices and plates must be fitted when operating.*
Use approved tools only when handling knife blade type fuses in the battery fuse board.

7.2 PREPARATORY INSPECTION

7.2.1 General

Check that the equipment is free from damage, correctly fitted and anchored and that all the ventilation openings are free from obstacles.

Check that all cable installations, electrical connections and protective earths are correctly implemented. Check that non fuse protected battery cables are double insulated and separated from other cables and combustible substances.

Check that all protective covers are intact, all breakers are switched off and all fuses switched off or removed.

Check that the number of battery blocks is according to specification.

7.2.2 Battery

Check that all battery blocks are properly connected by measuring some block voltages, multiply the mean value of these voltages with the number of blocks and finally compare the result with the measured total battery voltage.

Check that a possible temperature sensor (option) is placed on a spot that best represents the temperature of the battery.

Check that correct battery voltage is present in the battery fuse board. Ensure that the polarity is correct according to the markings.

7.3 POWERING UP

7.3.1 DC

7.3.1.1 Monitoring unit

Fit in the knife blade fuses in the battery fuse board that feeds the monitoring unit (see site specific circuit diagram). After a few seconds, the operator's panel display lights up, and after a few more seconds text appears on the display. All measurement values are initially reset. The measurement starts after about 10 seconds. Alarms are activated after about 30 seconds.

7.3.1.2 DC Distribution fuse board

Ensure that all fuses in the distribution fuse boards are removed or switched off. Push knife blade fuses in place for the fuse ways in the battery fuse board that feeds the distribution fuse boards (see site specific circuit diagram).
Fuse links in possible main fuse board are put in place.

If the system is equipped with cross-link breakers, switch on the breaker for feeding from the battery in operation.

The LED lamps for each fuse way should now start to shine red.

7.3.1.3 Rectifier modules

Connect the rectifier module outputs by fitting in the knife blade fuses for the corresponding fuse way in the battery fuse board (see site specific circuit diagram). Nothing visible occurs in this state.

7.3.1.4 DC/DC converter

Option 1, DC/DC converter is fed directly from the battery fuse board:
Fit in the knife blade fuses in the battery fuse board that feeds the DC/DC converter. In case of a main fuse board it may have corresponding fuses that should be put in place.

Option 2, DC/DC converter is fed from fuse in the distribution fuse board:
Put in place or turn on the fuse in the distribution fuse board that feeds the DC/DC converter.

In some cases the DC/DC converter is fed through a load break switch or a cross-link breaker. Then switch on the breaker for feeding from the battery in operation.

On the DC/DC converter a lamp should light up indicating OK and voltage (normally 24 or 48V) should be present on the output terminals. If the DC/DC converter is followed by a distribution fuse board of type DM199 the LED lamps for each fuse way in the board should now start to shine red.

7.3.1.5 Inverter

Ensure that the switch on the front of the inverter is turned off and that the bypass switch is in position “Normal”.

Option 1, inverter is fed directly from the battery fuse board:
Fit in the knife blade fuses in the battery fuse board that feeds the inverter. In case of a main fuse board it may have corresponding fuses that should be put in place.

Option 2, inverter is fed from fuse in the distribution fuse board:
Put in place or turn on the fuse in the distribution fuse board that feeds the inverter.

In some cases the inverter is fed through a load break switch or a cross-link breaker. Then switch on the breaker for feeding from the battery in operation.

Turn on the switch for DC infeed to the inverter.

7.3.1.6 Others

For possible other units, see separate descriptions for each unit.

7.3.2 AC

7.3.2.1 Rectifier modules

Turn on the mains input switch for the rectifier. The rectifiers will now start up.

The battery now starts to charge, and if it was in a state of deep discharge, the charging starts with rated current until the float charging level is reached. Certain types of batteries require an initial equalizing charging. Always follow the recommendations given by the battery manufacturer.

7.3.2.2 Inverter

Switch on the bypass mains by e.g. engaging an external breaker or fuse.

Start the inverter by turning on the switch on the front of the inverter.

Select desired operating condition, inverter mode or mains mode. See *Manual for Inverter type INVB* if needed.

7.3.2.3 Others

For mains feeding of possible other units, see separate descriptions for each unit.

7.4 CHECKING

7.4.1 Checking the charging voltage

Check the settings of the monitoring unit to ensure that the voltage level for float charging and equalizing charging conform to the battery manufacturer's specifications, see *Manual for Monitoring unit type PCM2.*

When the battery is charged to a level where the "High current" alarm is no longer active, you should check that the actual output voltage conforms with the setting of the float charging voltage, see section 8.1.2 Checking the charging voltage.

7.4.2 Checking the settings

Each time the monitoring unit has been powered down, the built-in clock must be reset with the current date and time, see the *Manual for Monitoring unit type PCM2*.

Check that the measurements on the display agree with the actual situation. Check that the parameters for charging voltages, alarms and other parameters conform to the intended functions, see the *Manual for Monitoring unit type PCM2.*

7.4.3 Checking of outputs

The alarm outputs A-D and the output for fan control can be operated manually for simple and smooth checking of external circuits, see *the Manual for Monitoring unit type PCM2*.

7.4.4 Checking of double systems

The two systems A and B are placed in separate cubicles. Normally the cubicles are attached and the signalling between the systems is premade. But sometimes the cubicles are shipped as separated units where the signalling circuits are to be connected on site. In that case the circuits should be checked during commissioning according to the instructions below.

7.4.4.1 Test of the function "Blocking of equalizing charging"

1. Use the menu system of the display unit for system A to select *Advanced/Test&Calibrate/Show digital in*.
2. Switch off all cross-link breakers that are feeding out from battery A. The status for the input "EQ disable" should show "closed".
3. Switch on/off, one at a time, the cross-link breakers that are feeding out from battery A. In position "on" the status for the input "EQ disable" should show "open".

Repeat the same procedure for the display unit in system B but with cross-link breakers that are feeding out from battery B.

7.4.4.2 Test of the function "Blocking of earth fault measuring"

1. Use the menu system of the display unit for system A to select *Advanced/Test&Calibrate/Show digital in*.

2. Switch on all cross-link breakers that are feeding out from battery A and turn off the others. The status for the input "*EF Bl./Test*" should show "closed".
3. Switch on/off, one at a time, the cross-link breakers that is feeding out from battery B. In position "on" the status for the input "*EF Bl./Test*" should show "open".

7.4.4.3 Test of the function "Battery circuit test"

1. Use the menu system of the display unit for system A to select *Advanced/Test&Calibrate/Show digital out/Other*. Set the output "Test" in position "On".
2. Use the menu system of the display unit in system B to select *Advanced/Test&Calibrate/Show digital in*. Check that the input "*EF Bl./Test*" shows "closed".
3. In the display unit for system A, set the output "Test" in position "Off".
4. Check that the input "*EF Bl./Test*" in the display unit for system B shows "open".

7.5 CONNECTION OF LOADS

Put in place or turn on the fuses in the distribution fuse boards. The fuse way indication lamps should then gradually turn to green light. When this is finished, no more alarms should remain on the display.

Eventually, turn on the loads that are connected to the distribution outputs.

8 MAINTENANCE

8.1 ANNUAL INSPECTION

8.1.1 General

In addition to these instructions, you must observe the instructions for maintenance in the *Manual for Monitoring unit type PCM2*, maintenance instructions for possible other units and the battery manufacturer's maintenance instructions.

8.1.2 Checking the charging voltage

Connect a voltmeter to the test contacts (see section 5.9 TEST CONTACTS). Check that the rectifier's output voltage corresponds to the setting of the float charging level.

If the float charging voltage is temperature controlled, it is difficult to determine what the expected output voltage should be. The solution is to temporarily shut down the temperature control. You do this using the menu option *Functions, battery temperature* to specify that the temperature sensor is not installed (see the *Manual for Monitoring unit type PCM2*, section *Operation, Functions*). Do not forget to reset the parameter for the installed temperature sensor following the completed measurement!

All control is based on measurement. If charge voltage is found to be in a state of non-conformance it is therefore the voltage measurement that should be calibrated, see the instructions for maintenance in the *Manual for Monitoring unit type PCM2*.

8.1.3 Checking the cooling capacity

Check that the rectifier modules' ventilation vents are not clogged with dust or other contaminants. Clean where necessary.

8.1.4 Other

For maintenance of possible other units, see separate descriptions for each unit.

9 FAULT TRACING

9.1 SAFETY INSTRUCTIONS

DANGER! *This product contains dangerous voltages that when touched can cause electric shock, burns or death.*
Service/maintenance work that involves working inside apparatus or with removed protective coverings may only be carried out by authorised service personnel (see section ***Fel! Hittar inte referenskälla.*** *SAFETY INSTRUCTIONS).*

9.2 FAULT TRACING ALARMS

Fault tracing in connection with alarm messages presented on the operator's panel of the monitoring unit is described in the *Manual for Monitoring unit type PCM2*.

For fault tracing of possible other units, see separate descriptions for each unit.

9.3 FAULT TRACING FOR RECTIFIER

The types of faults that can be attributed to the rectifier, mainly rectifiers of type PRM1, are dealt with here. For faults that relate to the monitoring unit, see the *Manual for Monitoring unit type PCM2*.

The primary fuse trips when the rectifier is turned on

Cause 1: Wrong type of external primary fuse. Check that the system is properly fused according to the instructions in section 6.5.3.1 External fuse rating.
Cause 2: Internal fault in a rectifier module. Install one module at a time in order to identify the module that is responsible for the problem. Replace the defective module.

The rectifier has no output, green indicator lamp "AC OK" is off

Cause 1: No mains power. Check that there is mains voltage to the mains input terminals and that the mains breaker is closed.
Cause 2: A rectifier module is not fully inserted.

The rectifier has no output, green indicator lamps "AC OK" and "DC OK" are lit

Cause 1: Input "EXT. FAULT" is used as external blocking and is in open state.
Cause 2: Output fuse for the rectifier in the battery fuse board has tripped. Check that the output fuses are properly dimensioned to handle the rectifier's rated current.

The rectifier module's green indicator lamp "AC OK" is lit and "DC OK" is off

Cause 1: The rectifier module may be faulty. Replace the rectifier module.
Cause 2: If the red "ALM" lamp is also lit, the cause may be that the rectifier module has been tripped by high output voltage, HVSD (High Voltage Shut Down). Reset by removing power to the module, most simply by extracting the module for a few seconds until all lamps are off, and then re-inserting it again. If the fault reoccurs, the module may be faulty. Replace the rectifier module.

The rectifier module's red indicator lamp "ALM" is lit

Cause 1: Unless the cause is obvious, e.g. see the alternatives above, you can view the status of the rectifier module in detail via the display on the monitoring unit, see the *Manual for Monitoring unit type PCM2*.

The rectifier output voltage is too low

Cause 1: The rectifier load is greater than its capacity (rated current). This is usual in connection with recharging following a deep discharge.
Cause 2: A battery circuit test is in progress. This is a test that is normally executed automatically once a day.
Cause 3: The selected charging voltage (float charge or equalization charge) is close to or greater than the limit for parameter $U_{maximum}$. The output voltage cannot exceed ($U_{maximum}$ – 1%). If a higher charging voltage is required, the value of $U_{maximum}$ must be increased, see *Manual for Monitoring unit type PCM2.*
Cause 4: High temperature in battery/battery room. Only applicable if the rectifier controls the temperature of the float charging voltage. There is no fault with the rectifier in this case. Look for the fault in the high temperature instead. Alternatively the temperature sensor could be defective. Check whether the display is reporting the correct battery temperature.
Cause 5: Incorrect float charging voltage level setting. Adjust the setting.
Cause 6: Incorrectly calibrated voltage measurement. Recalibrate the monitoring unit's measurement of battery voltage.

The rectifier output voltage is too high

Cause 1: Equalization charging in progress. This has either been initiated manually or automatically following a power failure.
Cause 2: Low temperature in battery/battery room. Only applicable if the rectifier controls the temperature of the float charging voltage. There is no fault with the rectifier in this case. Look for the fault in the low temperature instead. Alternatively the temperature sensor could be defective. Check whether the display is reporting the correct battery temperature.
Cause 3: Incorrect float charging voltage level setting. Adjust the setting.
Cause 4: Incorrectly calibrated voltage measurement. Recalibrate the monitoring unit's measurement of battery voltage.

9.4 OTHER FAULT TRACING

9.4.1 Distribution fuse module type DM199

All LED indication lamps within a module is off.

Cause 1: Input power to the module is missing. Check possible mains infeed switch and upstream fuse in the battery fuse board and main fuse board.
Cause 2: All DIL-switches for alarm indications on the back of the distribution fuse board are set in deactivated position (see section 6.5.6).
Cause 3: Possible fault in the fuse monitoring board. Replace the faulty circuit board.

An individual LED indication lamp within a module is off

Cause 1: Corresponding DIL-switch for alarm indications on the back of the distribution fuse board is set in deactivated position.
Cause 2: Possible fault in the fuse monitoring board. Replace the faulty circuit board.

An individual LED indication lamp within a module has turned red

Cause 1: A fuse in the monitored fuse way has tripped. The unit indicates an alarm as intended.
Cause 2: Possible fault in the fuse monitoring board. Replace the faulty circuit board.

Alarm output does not respond to fuse fault despite red indication light

Cause 1: Corresponding DIL-switch for alarm relay on the back of the distribution fuse board is set in deactivated position.
Cause 2: Possible fault in the fuse monitoring board. Replace the faulty circuit board.

9.4.2 DC/DC converter

DC/DC converter gives alarm, all LED indication lamps are off, no output voltage

Cause 1: Power infeed to the converter is missing. Check possible infeed switch and upstream fuse in the battery fuse board and main fuse board.
Cause 2: Possible fault in the converter. Replace the faulty unit.

DC/DC converter gives alarm, LED lamps indicates alarm, low output voltage

Cause 1: The load exceeds the rated current of the converter.
Cause 2: Low input voltage.
Cause 3: Possible fault in the converter. Replace the faulty unit.

Other fault conditions

See possible separate description for the DC/DC converter.

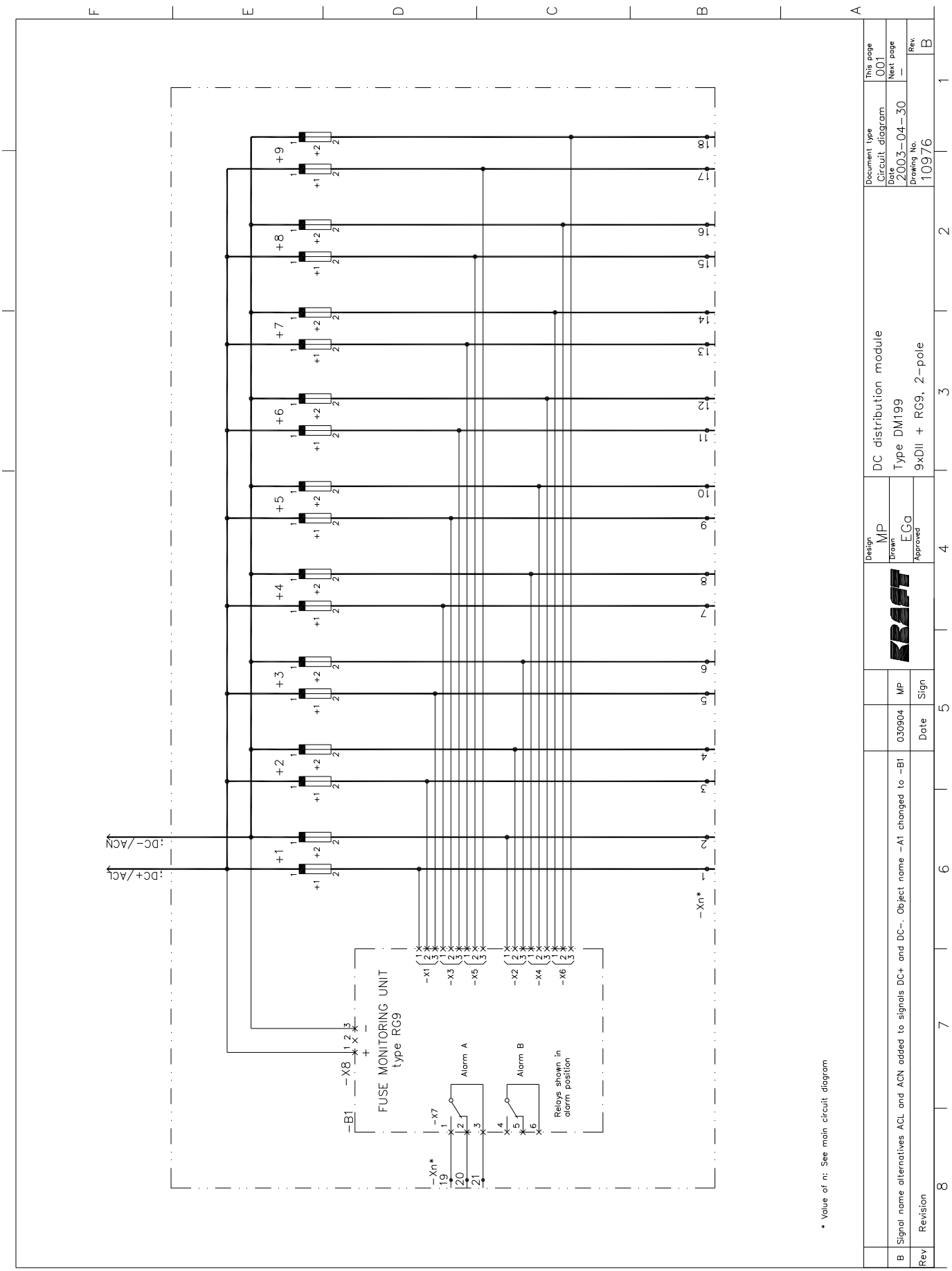
9.4.3 Inverter

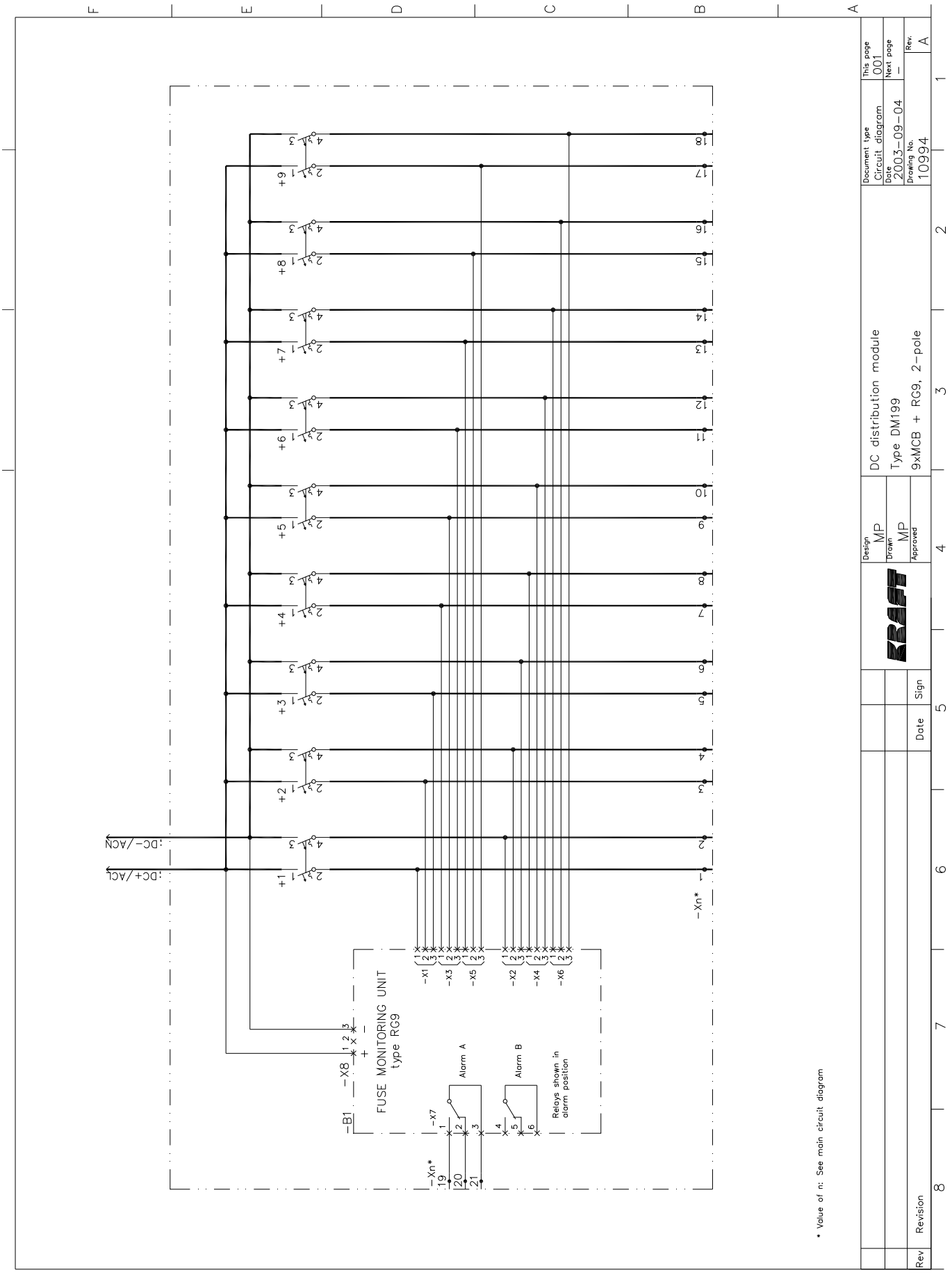
See fault tracing instructions in the *Manual for Inverter type INVB*.

9.4.4 Other units

For fault tracing of possible other units, see separate descriptions for each unit.

Appendix A
CIRCUIT DIAGRAM DM199




DC distribution module
Type DM199
9xMCB + RG9, 2-pole
Design MP
Drawn MP
Approved
Document type Circuit diagram
Date 2003-09-04
Drawing No. 10994
This page 001
Next page –
Rev. A
Rev Revision Date Sign
FUSE MONITORING UNIT type RG9
-B1
-X8
-X7
-Xn*
Alarm A
Alarm B
Relays shown in alarm position
-X1
-X2
-X3
-X4
-X5
-X6
DC+/AC1
DC-/AC2
+1
+2
+3
+4
+5
+6
+7
+8
+9
* Value of n: See main circuit diagram